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## ON ENTIRE AND MEROMORPHIC FUNCTIONS THAT SHARE SMALL FUNCTIONS WITH THEIR DERIVATIVES

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## Abstract

In this paper, it is shown that if  $f$  is a non-constant entire function,  $f$  and  $f^{(k)}$  share the small function  $a (\neq 0, \infty)$  **CM** and  $\delta(0, f) > \frac{3}{4}$ , then  $f \equiv f^{(k)}$ . Furthermore, if  $f$  is non-constant meromorphic,  $f$  and  $a$  do not have any common pole and  $4\delta(0, f) + 2(8+k)\Theta(\infty, f) > 19 + 2k$ , then the same conclusion can be obtained. Finally, some open questions are posed for the reader.

*2000 Mathematics Subject Classification:* Primary 30D35.

*Key words:* Derivatives, Entire functions, Meromorphic functions, Nevanlinna theory, Sharing values, Small functions.

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# 1. Introduction and the Main Results

Given two non-constant meromorphic functions  $f$  and  $g$ , it is said that they share a finite value  $a$  **IM** (ignoring multiplicities) if  $f - a$  and  $g - a$  have the same zeros. If  $f - a$  and  $g - a$  have the same zeros with the same multiplicity, then we say that  $f$  and  $g$  share the value  $a$  **CM** (counting multiplicity). In this paper, we assume that the reader is familiar with the basic concepts of Nevanlinna value distribution theory and the notations  $m(r, f)$ ,  $N(r, f)$ ,  $\bar{N}(r, f)$ ,  $T(r, f)$ ,  $S(r, f)$  and etc., see e.g. [5].

L.A. Rubel and C.C. Yang [8], E. Mues and N. Steinmetz [7], G.G. Gundersen [3] and L.Z. Yang [9] have completed work on the uniqueness problem of entire functions with their first or  $k$ -th derivatives involving two **CM** or **IM** values. J.H. Zheng and S.P. Wang [12] considered the uniqueness problem of entire functions that share two small functions **CM**. In the aspect of only one **CM** value, R. Brück [1] posed the following question:

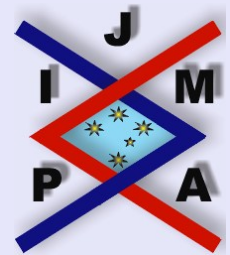
*What results can be obtained if one assumes that  $f$  and  $f'$  share only one value **CM** plus some growth condition?*

In fact, he presented the following conjecture.

**Conjecture 1.1.** *Let  $f$  be a non-constant entire function. Suppose that  $\rho_1(f) < \infty$ ,  $\rho_1(f)$  is not a positive integer and  $f$  and  $f'$  share one finite value  $a$  **CM**. Then*

$$\frac{f' - a}{f - a} = c$$

*for some non-zero constant  $c$ . Here  $\rho_1(f)$  denotes the first iterated order of  $f$ .*



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He also showed in the same paper that the conjecture is true if  $a = 0$  and  $N\left(r, \frac{1}{f'}\right) = S(r, f)$ . Furthermore in 1998, G.G. Gundersen and L.Z. Yang [4] showed that the conjecture is true if  $f$  is of finite order. Therefore, it is natural to consider whether there exist any similar results for infinite order entire, or even meromorphic, functions  $f$  and small function  $a$  of  $f$  if we keep the condition  $N\left(r, \frac{1}{f'}\right) = S(r, f)$  or replace  $N\left(r, \frac{1}{f'}\right)$  by  $N\left(r, \frac{1}{f}\right)$  (or  $\delta(0, f)$ ). In this paper, we answer this question and actually show that the following results hold.

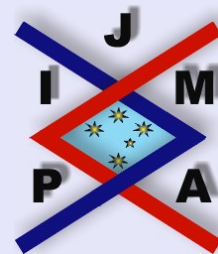
**Theorem 1.2.** *Let  $k \geq 1$ . Let  $f$  be a non-constant entire function and  $a(z)$  be a meromorphic function such that  $a(z) \not\equiv 0, \infty$  and  $T(r, a) = o(T(r, f))$  as  $r \rightarrow +\infty$ . If  $f - a$  and  $f^{(k)} - a$  share the value 0 **CM** and  $\delta(0, f) > \frac{3}{4}$ , then  $f \equiv f^{(k)}$ .*

**Corollary 1.3.** *Let  $f$  be a non-constant entire function and  $k$  be any positive integer. Suppose that  $f$  and  $f^{(k)}$  share the value 1 **CM** and that  $\delta(0, f) > \frac{3}{4}$ . Then  $f \equiv f^{(k)}$ .*

For non-entire meromorphic functions, we have

**Theorem 1.4.** *Let  $k \geq 1$ . Let  $f$  be a non-constant, non-entire meromorphic function and  $a(z)$  be a meromorphic function such that  $a(z) \not\equiv 0, \infty$ ,  $f$  and  $a$  do not have any common pole and  $T(r, a) = o(T(r, f))$  as  $r \rightarrow +\infty$ . If  $f - a$  and  $f^{(k)} - a$  share the value 0 **CM** and  $4\delta(0, f) + 2(8 + k)\Theta(\infty, f) > 19 + 2k$ , then  $f \equiv f^{(k)}$ .*

**Corollary 1.5.** *Let  $f$  be a non-constant, non-entire meromorphic function and  $k$  be any positive integer. Suppose that  $f$  and  $f^{(k)}$  share the value 1 **CM** and that  $4\delta(0, f) + 2(8 + k)\Theta(\infty, f) > 19 + 2k$ . Then  $f \equiv f^{(k)}$ .*



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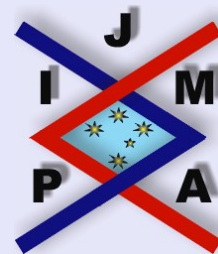
If we compare our results with the conjecture, it can be seen that we do not assume any restriction on the growth of  $f$ . In fact, our results show that under the condition

$$\delta(0, f) > \frac{3}{4}$$

or

$$4\delta(0, f) + 2(8 + k)\Theta(\infty, f) > 19 + 2k,$$

we can prove the conjecture is true even for small functions  $a$  of even or meromorphic  $f$  and the constant  $c$  is 1.



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## 2. Some Lemmas

In this section, we have the following lemmas which will be needed in the proofs of the main results. In the following,  $I$  is a set of infinite linear measure and may not be the same each time it occurs.

**Lemma 2.1.** *Let  $f$  be a meromorphic function in the complex plane. For any positive integer  $k$ , we have*

$$N\left(r, \frac{1}{f^{(k)}}\right) \leq N\left(r, \frac{1}{f}\right) + k\bar{N}(r, f) + S(r, f).$$

**Lemma 2.2.** [10] *Let  $f_1, f_2$  be non-constant meromorphic functions and let  $c_1, c_2$  and  $c_3$  be non-zero constants. If  $c_1f_1 + c_2f_2 = c_3$  holds, then*

$$T(r, f_1) < \bar{N}\left(r, \frac{1}{f_1}\right) + \bar{N}\left(r, \frac{1}{f_2}\right) + \bar{N}(r, f_1) + S(r, f_1),$$

$r \in I$ .

**Lemma 2.3.** [2] *Let  $f_j$  ( $j = 1, 2, \dots, n$ ) be  $n$  linearly independent meromorphic functions. If they satisfy*

$$\sum_{j=1}^n f_j \equiv 1,$$

*then for  $1 \leq j \leq n$ , we have*

$$T(r, f_j) < \sum_{k=1}^n N\left(r, \frac{1}{f_k}\right) + N(r, f_j) + N(r, D) - \sum_{k=1}^n N(r, f_k) - N\left(r, \frac{1}{D}\right) + S(r),$$



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where  $D$  is the Wronskian determinant  $W(f_1, f_2, \dots, f_n)$ ,  $S(r) = o(T(r))$ , as  $r \rightarrow +\infty$ ,  $r \in I$  and  $T(r) = \max_{1 \leq k \leq n} T(r, f_k)$ .

The following lemma was proven by H.X. Yi in [11].

**Lemma 2.4.** *Let  $f_j$  ( $j = 1, 2, 3$ ) be meromorphic and  $f_1$  be non-constant. Suppose that*

$$(2.1) \quad \sum_{j=1}^3 f_j \equiv 1$$

and

$$(2.2) \quad \sum_{j=1}^3 N\left(r, \frac{1}{f_j}\right) + 2 \sum_{j=1}^3 \bar{N}(r, f_j) < (\lambda + o(1))T(r),$$

as  $r \rightarrow +\infty$ ,  $r \in I$ ,  $\lambda < 1$  and  $T(r) = \max_{1 \leq j \leq 3} T(r, f_j)$ . Then  $f_2 \equiv 1$  or  $f_3 \equiv 1$ .

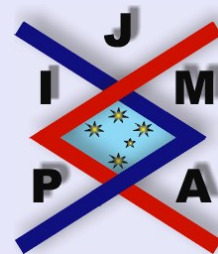
**Lemma 2.5.** [6] *Let  $f$  be a transcendental meromorphic function and  $K > 1$ , then there exists a set  $M(K)$  of upper logarithmic density at most*

$$\delta(K) = \min \left\{ (2e^{K-1} - 1)^{-1}, (1 + e^{(K-1)})e^{e^{(1-K)}} \right\}$$

such that for every positive integer  $k$ ,

$$\limsup_{r \rightarrow +\infty, r \notin M(K)} \frac{T(r, f)}{T(r, f^{(k)})} \leq 3eK.$$

If  $f$  is entire, then  $3eK$  can be replaced by  $2eK$  in the above inequality.



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### 3. Proofs of Theorem 1.2 and Theorem 1.4

*Proof of Theorem 1.2.* First of all, we write

$$(3.1) \quad F = \frac{f^{(k)} - a}{f - a}.$$

Now a pole of  $F$  must be a zero of  $f - a$  or a pole of  $f^{(k)} - a$ . Since  $f - a$  and  $f^{(k)} - a$  share the value 0 **CM**, poles of  $F$  cannot be zeros of  $f - a$ . Furthermore,  $f$  is assumed to be entire, the poles of  $f^{(k)} - a$  are the poles of  $a$ . It follows that if  $z_0$  is a pole of  $a$ , then  $F(z_0) = 1$ . Hence,  $F$  has no pole in the complex plane. By similar reasoning, we can show that  $F$  does not have any zero.

Therefore, we deduce from (3.1) that

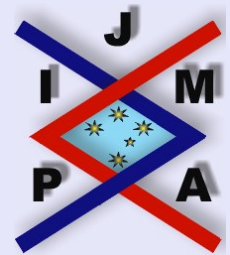
$$(3.2) \quad \frac{f^{(k)} - a}{f - a} = e^g$$

where  $g$  is an entire function. Let  $f_1 = \frac{f^{(k)}}{a}$ ,  $f_2 = -\frac{e^g f}{a}$  and  $f_3 = e^g$ . Thus from (3.2), we have

$$(3.3) \quad f_1 + f_2 + f_3 = 1.$$

By Lemma 2.5, we see that  $f_1 = \frac{f^{(k)}}{a}$  is non-constant. Hence, by Lemma 2.1,

$$\begin{aligned} & \sum_{j=1}^3 N\left(r, \frac{1}{f_j}\right) + 2 \sum_{j=1}^3 N(r, f_j) \\ &= N\left(r, \frac{a}{f^{(k)}}\right) + N\left(r, \frac{a}{f e^g}\right) + N\left(r, \frac{1}{e^g}\right) \end{aligned}$$



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$$\leq 2N\left(r, \frac{1}{f}\right) + S(r, f).$$

as  $r \rightarrow +\infty$ ,  $r \in I$ . On the other hand, since

$$\begin{aligned} T(r, f) &= T\left(r, \frac{af_2}{-f_3}\right) \\ &\leq T(r, f_2) + T(r, a) + T(r, f_3) \\ &\leq 2T(r) + S(r, f), \end{aligned}$$

where  $T(r) = \max_{1 \leq j \leq 3} T(r, f_j)$ , it follows from  $\delta(0, f) > \frac{3}{4}$  that

$$\begin{aligned} 2N\left(r, \frac{1}{f}\right) &< (\lambda + o(1)) \frac{T(r, f)}{2} \\ &\leq (\lambda + o(1))T(r) \end{aligned}$$

as  $r \rightarrow +\infty$ ,  $r \in I$  and  $\lambda < 1$ . So by Lemma 2.4,  $\frac{fe^g}{a} \equiv -1$  or  $e^g \equiv 1$ .

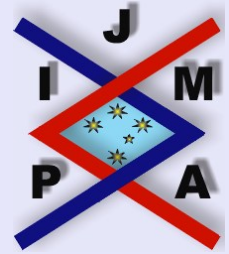
**Case 3.1.** If  $e^g \equiv 1$ , then we have  $f \equiv f^{(k)}$  by (3.2).

**Case 3.2.** If  $fe^g \equiv -a$ , then

$$(3.4) \quad f = -ae^{-g}.$$

By (3.2),

$$(3.5) \quad ff^{(k)} = a^2.$$



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By differentiating both sides of (3.4)  $k$  times, we obtain

$$(3.6) \quad f^{(k)} = Q(g)e^{-g},$$

where  $Q(g)$  is a differential polynomial of  $g$  with small functions with respect to  $f$ , and hence to  $e^g$  by (3.4). Therefore, by (3.4), (3.5) and (3.6), we get a contradiction that  $T(r, f) = o(T(r, f))$  as  $r \rightarrow +\infty, r \in I$  in this case. □

*Proof of Theorem 1.4.* To prove Theorem 1.4, we first need to reconsider (3.1). Since  $f$  is non-entire meromorphic, we can use the same argument to show that the function  $F$  in (3.1) does not have any zero. Hence,  $F$  has the form  $he^g$ , where  $g$  is an entire function and  $h$  is a non-zero meromorphic function. Now it is clear that the poles of  $h$  come from the poles of  $f$  or  $a$  and furthermore, we have the following

$$(3.7) \quad \bar{N}(r, h) \leq \bar{N}(r, f) + S(r, f).$$

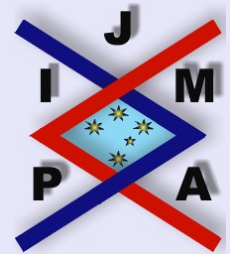
Therefore, instead of (3.2), we have

$$\frac{f^{(k)} - a}{f - a} = he^g$$

and thus

$$f_1 + f_2 + f_3 = 1,$$

where  $f_1 = \frac{f^{(k)}}{a}$ ,  $f_2 = \frac{-he^g f}{a}$  and  $f_3 = he^g$ .



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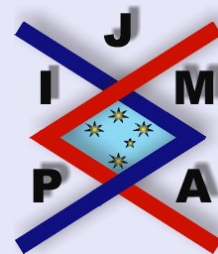
By Lemma 2.1 and (3.7), we have

$$\begin{aligned}
 & N\left(r, \frac{a}{f^{(k)}}\right) + N\left(r, \frac{a}{hfe^g}\right) + N\left(r, \frac{1}{he^g}\right) \\
 & \quad + 2\left[\bar{N}\left(r, \frac{f^{(k)}}{a}\right) + \bar{N}\left(r, \frac{he^g f^{(k)}}{a}\right) + \bar{N}(r, he^g)\right] \\
 & \leq N\left(r, \frac{1}{f}\right) + k\bar{N}(r, f) + N\left(r, \frac{1}{f}\right) + 2[2\bar{N}(r, f) + 2\bar{N}(r, h)] + S(r, f) \\
 & \leq N\left(r, \frac{1}{f}\right) + k\bar{N}(r, f) + N\left(r, \frac{1}{f}\right) + 8\bar{N}(r, f) + S(r, f) \\
 & = 2N\left(r, \frac{1}{f}\right) + (8+k)\bar{N}(r, f) + S(r, f)
 \end{aligned}$$

as  $r \rightarrow +\infty$ ,  $r \in I$ . On the other hand, it follows from the condition  $4\delta(0, f) + 2(8+k)\Theta(\infty, f) > 19 + 2k$  that

$$\begin{aligned}
 & N\left(r, \frac{a}{f^{(k)}}\right) + N\left(r, \frac{a}{hfe^g}\right) + N\left(r, \frac{1}{he^g}\right) \\
 & \quad + 2\left[\bar{N}\left(r, \frac{f^{(k)}}{a}\right) + \bar{N}\left(r, \frac{he^g f^{(k)}}{a}\right) + \bar{N}(r, he^g)\right] \\
 & < (\lambda + o(1))\frac{T(r, f)}{2} \\
 & \leq (\lambda + o(1))T(r)
 \end{aligned}$$

as  $r \rightarrow +\infty$ ,  $r \in I$  and  $\lambda < 1$ . Therefore, as in the proof of Theorem 1.2, we have  $\frac{fhe^g}{a} \equiv -1$  or  $he^g \equiv 1$ .



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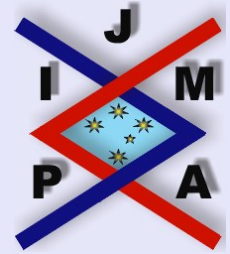
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**Case 3.1.** If  $he^g \equiv 1$ , then  $e^g = \frac{1}{h}$  which is a contradiction because  $h$  is a non-entire meromorphic function.

**Case 3.2.** If  $\frac{fhe^g}{a} \equiv -1$ , then  $f = -\frac{ae^{-g}}{h}$  and we still have (3.5) in this case. Since  $f$  is non-entire meromorphic, we let  $z_0$  be a pole of  $f$ . Then we see that  $f$  and  $a$  have  $z_0$  as their common pole which is a contradiction.

□

**Remark 3.1.** It is easily seen that Corollaries 1.3 and 1.5 are true if we take  $a(z) \equiv 1$  in Theorems 1.2 and 1.4 respectively.



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## 4. Final Remarks

**Remark 4.1.** By the remark pertaining to Theorem 2 in [12], we have the following example which shows that the conditions  $0 \mathbf{IM}$  and  $\delta(0, f) > \frac{3}{4}$  are not sufficient for meromorphic functions in the above theorems and corollaries.

**Example 4.1.**

$$f(z) = \frac{2A}{1 - e^{-2z}}, \quad f'(z) = -\frac{4Ae^{-2z}}{(1 - e^{-2z})^2},$$

where  $A \neq 0$ , then

$$f(z) - A = \frac{A(1 + e^{-2z})}{1 - e^{-2z}}, \quad f'(z) - A = -\frac{A(1 + e^{-2z})^2}{(1 - e^{-2z})^2}.$$

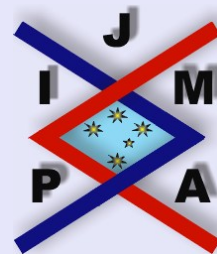
Here, it is easily seen that  $A$  is an  $\mathbf{IM}$  shared value of  $f$  and  $f'$ ,  $0$  is a Picard value of  $f$  and  $f'$  (i.e.  $\delta(0, f) = 1$ ), but  $f \not\equiv f'$ .

**Remark 4.2.** Next, we extend our results to the “ $\mathbf{CM}$ ” shared value. Let us recall the definition first. Let  $f(z)$  and  $g(z)$  be non-constant meromorphic functions,  $a$  is any complex number. We denote  $N_E(r, a)$  to be the reduced counting function of the common zero (with the same multiplicity) of  $f - a$  and  $g - a$ . If

$$\overline{N} \left( r, \frac{1}{f - a} \right) - N_E(r, a) = S(r, f)$$

and

$$\overline{N} \left( r, \frac{1}{g - a} \right) - N_E(r, a) = S(r, g),$$



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then  $a$  is said to be a “**CM**” shared value of  $f$  and  $g$ . The case for small functions of  $f$  and  $g$  is similar. In this case, the function  $h$ , mentioned in Section 3, will be allowed to have zero with  $\overline{N}\left(r, \frac{1}{h}\right) = S(r, f)$ . Therefore, it is easily seen that the results are also valid if we replace the **CM** shared value by the “**CM**” shared value. That is

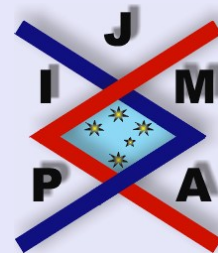
**Theorem 4.1.** Let  $k \geq 1$ . Let  $f$  be a non-constant entire function and  $a(z)$  be a meromorphic function such that  $a(z) \not\equiv 0, \infty$ , and  $T(r, a) = o(T(r, f))$  as  $r \rightarrow +\infty$ . If  $f - a$  and  $f^{(k)} - a$  share the value 0 “**CM**” and  $\delta(0, f) > \frac{3}{4}$ , then  $f \equiv f^{(k)}$ .

**Theorem 4.2.** Let  $k \geq 1$ . Let  $f$  be a non-constant meromorphic function and  $a(z)$  be a meromorphic function such that  $a(z) \not\equiv 0, \infty$ ,  $f$  and  $a$  do not have any common pole and  $T(r, a) = o(T(r, f))$  as  $r \rightarrow +\infty$ . If  $f - a$  and  $f^{(k)} - a$  share the value 0 “**CM**” and  $4\delta(0, f) + 2(8 + k)\Theta(\infty, f) > 19 + 2k$ , then  $f \equiv f^{(k)}$ .

The proofs are similar to the ones of Theorem 1.2 and Theorem 1.4.

**Remark 4.3.** One may ask what we can obtain if  $f$  and  $a$  are allowed to have a common pole in Theorem 1.4. In fact, by (3.5) we have the following.

**Theorem 4.3.** Suppose that  $k$  is an odd integer. Then Theorem 1.4 is valid for all small functions  $a$ .



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## 5. Four Open Questions

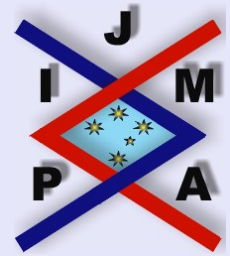
Finally, we pose the following natural questions for the reader.

**Question 1.** *Can a **CM** shared value be replaced by an **IM** shared value in Theorem 1.2 and Corollary 1.3?*

**Question 2.** *Is the condition  $\delta(0, f) > \frac{3}{4}$  sharp in Theorem 1.2 and Corollary 1.3?*

**Question 3.** *Is the condition  $4\delta(0, f) + 2(8 + k)\Theta(\infty, f) > 19 + 2k$  sharp in Theorem 1.4 and Corollary 1.5?*

**Question 4.** *Can the condition “ $f$  and  $a$  do not have any common pole” be deleted in Theorem 1.4 and Theorem 4.2?*



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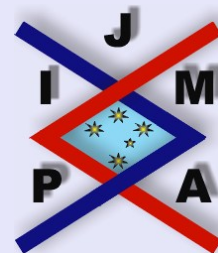
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## References

- [1] R. BRÜCK, On entire functions which share one value CM with their first derivative, *Result. in Math.*, **30** (1996), 21–24.
- [2] F. GROSS, *Factorization of Meromorphic Functions*, U.S. Govt. Printing Office Publications, Washington, D. C., 1972.
- [3] G.G. GUNDERSEN, Meromorphic functions that share finite values with their derivative, *J. Math. Anal. Appl.*, **75** (1980), 441–446. (Correction: 86 (1982), 307.)
- [4] G.G. GUNDERSEN AND L.Z. YANG, Entire functions that share one value with one or two of their derivatives, *J. Math. Anal. Appl.*, **223** (1998), 88–95.
- [5] W.K. HANYMAN, *Meromorphic Functions*, Oxford, Clarendon Press, 1964.
- [6] W.K. HANYMAN AND J. MILES, On the growth of a meromorphic function and its derivatives, *Complex Variables Theory Appl.*, **12** (1989), 245–260.
- [7] E. MUES AND N. STEINMETZ, Meromorphe Funktionen, die mit ihrer ersten und zweiten Ableitung einen endlichen Wert teilen, *Complex Variables*, **6** (1986), 51–71.
- [8] L.A. RUBEL AND C.C. YANG, Values shared by an entire function and its derivative, in “*Complex Analysis, Kentucky 1976*” (Proc. Conf.), Lecture



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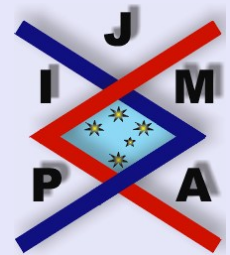
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Notes in Mathematics, Vol. 599, pp. 101–103, Springer-Verlag, Berlin, 1977.

- [9] L.Z. YANG, Entire functions that share finite values with their derivatives, *Bull. Austral. Math. Soc.*, **41** (1990), 337–342.
- [10] H.X. YI AND C.C. YANG, A uniqueness theorem for meromorphic functions whose  $n$ -th derivatives share the same 1-points, *J. Anal. Math.*, **62** (1994), 261–270.
- [11] H.X. YI AND C.C. YANG, *Uniqueness theorems of meromorphic functions* (Chinese), Science Press, Beijing, 1995.
- [12] J.H. ZHENG AND S.P. WANG, On unicity properties of meromorphic functions and their derivatives, *Adv. in Math.*, (China), **21** (1992), 334–341.



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